

INTEGRATED BASELINE DATA FOR REGIONAL PLANNING AND ENVIRONMENTAL ASSESSMENT  
IN THE MACKENZIE MOUNTAINS REGION, YUKON AND NORTHWEST TERRITORIES

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BACKGROUND

oughout Canada's North, there are increasing pressures to develop many of the non-renewable mineral and hydrocarbon resources. Pressures to develop the resources vary considerably from area to area based on a variety of factors, such as:

- market needs;
- market economic situation;
- quality and quantity of resources in any area;
- ease of extraction of the resource(s); and
- ease and cost of access to markets (e.g. by road, ship, pipeline, air, etc.).

There are presently four main regions in the North which are the focus of existing and potential development activities associated with non-renewable resources:

1. The Beaufort Sea and the surrounding mainland and islands are a centre of major interest for the oil and gas industries.
2. The Mackenzie Valley is of prime interest for pipelines for transporting oil and gas from more northern sites to southern markets. There is also ongoing and proposed hydrocarbon extraction in some areas of the Valley.
3. The Northwest Passage (Lancaster Sound and Viscount Melville Sound) and the surrounding Arctic Islands are mainly a centre of hydrocarbon exploration and proposed extraction and transportation. There is also mineral exploration and some ongoing mineral extraction.
4. The fourth area, the subject of this paper, is the Mackenzie Mountains Region of the Yukon Territory and the Northwest Territories, an area of intense mineral exploration, and especially for lead, zinc, tungsten, silver, and some copper.

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The implications of developments on the environment are peculiar to each region, and depend on the characteristics of the development type and aspects of the environment, such as climate, wildlife populations and habitat, river and stream characteristics, etc. For the Mackenzie Mountains Region, the primary development activities are mining related, and implications on the environment will be due to the following main activities:

- exploration to locate areas of mineral concentrations;
- construction of extraction facilities;
- extraction of resources from the ground and transportation of them to the mill;
- processing of extracted materials (crushing, grinding, concentration, dewatering, smelting, etc.); and
- transportation of minerals to markets.

Because of the extensive exploration activities in the region and the potential for development of many sites, a number of concerns for the environment of the area were expressed by various territorial and federal government agencies.

1. The region contains populations of a broad range of large mammals, including Dall's sheep or thinhorn sheep, mountain goat, woodland caribou, moose, grizzly bear, black bear, and wolf. There are also populations of a variety of furbearers, including beaver, otter, marten, fisher, and lynx. There has been considerable concern as to the potential effects of mining activities on the populations and habitats of these and other wildlife.
2. Considerable interest has been expressed about the potential effects of mining on the esthetics and wilderness values of the region. Most of the area presently has poor access and so has a high wilderness value. Mining haul and access roads could dramatically alter this.
3. There is also concern for effects of mining activities on the area's many rivers and streams, and particularly for the South Nahanni River and other rivers and streams which flow through Nahanni National Park. A large proportion of the exploration and other development activities are occurring in the South Nahanni River watershed, and virtually all of these are upstream of Nahanni National Park.
4. There is also the threat of potential damage to unique, rare, or exceptional biological or physical features, such as those identified through the International Biological Programme, Natural Areas of Canadian Significance, and Canadian Wildlife Service areas of wildlife significance.

### INTEGRATED BASELINE DATA FOR THE MACKENZIE MOUNTAINS REGION

With the above-noted concerns in mind, a need was perceived for environmental baseline data which would allow land planners and resource managers to assess the implications on the environment of proposed mineral developments. The Mackenzie Mountains Region data base is part of a series of data bases which have a basic core of similar information sets along with specialized data sets depending upon issues or concerns identified for the specific region. To-date, data bases have been completed for four geographic regions:

1. The Beaufort Sea Region -- This data base covers about 230,000 square kilometers of land around the Beaufort Sea. It includes most of Banks Island, most of the northern Yukon, and the northwestern portion of the District of Mackenzie, N.W.T.
2. Lancaster Sound and the surrounding islands -- Cornwallis, Devon, Somerset, Baffin, and many smaller islands.
3. Viscount Melville Sound and the surrounding islands -- Bathurst, Prince of Wales, Melville, Stefansson, Eglington, northern Victoria, and many smaller islands.
4. The Mackenzie Mountains Region of the Yukon and N.W.T., including several mountain ranges and the surrounding hills and plains of the region. The baseline study for this region was jointly funded by six territorial and federal agencies:
  - the Department of Renewable Resources of the Yukon Territory, Whitehorse;
  - the Department of Renewable Resources of the N.W.T., Yellowknife;
  - Parks Canada, Prairie Region, Winnipeg;
  - Department of Indian and Northern Affairs, Ottawa;
  - Western and Northern Region, Environment Canada, Edmonton; and
  - Lands Directorate, Environment Canada, Ottawa.

Based on discussions with study sponsors, a variety of types of data and information needs were identified for inclusion in the data base:

- areas identified as being of interest for conservation purposes;
- hydrologic features of the region;

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- physical and biological characteristics of the land; and
- mining, oil, and gas data.

#### PRODUCTS OF THE MACKENZIE MOUNTAINS REGION BASELINE STUDY

##### A) Maps and Map Overlays

Maps provide a geographic framework for all types of data and information compiled during the study. One of the main map components in the study was the ecodistrict base. Using the ecological land classification approach, ecodistrict lines were delineated on 1:250,000 scale N.T.S. map bases. For later ease of computer entry and reduction of costs, ecodistrict lines were transferred to 1:500,000 scale stable mylar map bases. To provide working copy maps, paper ozalid copies can be produced from the mylar, and additional stable mylar copies can be produced photomechanically so that survey sponsors can produce their own copies of ecodistrict maps as needed.

A number of map overlays were also produced on mylar and registered to the stable N.T.S. map base. These include:

- Areas of conservation interest, including parks, Natural Areas of Canadian Significance, IBP sites, areas of wildlife significance, etc.;
- Inland Waters Directorate drainage divisions; and
- Areas of mining, oil, and gas activity and interest.

##### B) Reports

A number of reports were prepared under the Mackenzie Mountains Region Baseline Study.

1. The first report prepared was a comprehensive Bibliography of reports, papers, and maps dealing with the study area. This was based on searches of several computer data bases, government libraries, and examination of Geological Survey of Canada published maps and open files. The bibliography was organized into ten subject categories:

- Geology
- Surficial geology
- Soils
- Mass movement
- Karst
- Glaciation
- Wildlife
- Vegetation
- Environmental impact
- General subject matter

2. The report "Part I -- Composite Data Set No. 1 and Composite Data Set No. 2" includes:

- background information concerning the study area and an introduction to the baseline study;
- political jurisdictions;
- major surface water bodies (rivers and streams);
- areas of interest for conservation purposes
  - International Biological Programme Proposed Ecological Sites
  - Natural Areas of Canadian Significance (NACS)
  - Parks (federal and territorial)
  - Canadian Wildlife Service Areas of Wildlife Significance
- Inland Waters Directorate drainage divisions.

3. There is a volume of "Ecodistrict Fact Sheets" for each of the five 1:500,000 scale map sheets which were mapped for ecodistricts. A total of 308 ecodistricts were delineated for the study area, and for each of these an "Ecodistrict Fact Sheet" was completed with data on the following:

- Macrotopography -- terrain/water ratio, relief, and slope inclination/direction;
- Landforms -- macro-landform, mode of origin, surface expression, modifying process, particle size, bedrock type, depth of material, etc.;
- Soils -- classification, reaction, texture, and moisture;
- Vegetation -- cover, associations, and primary species;
- Water -- lake size, shape, quality, and depth plus lakeshore association
  - river drainage density, native channel size, major channel pattern and major channel size.
- (landform, soil, vegetation, and water data are given for the primary, secondary, and tertiary groups in each category).
- Wildlife -- major species, habitat functions, and seasonality of use.

Fact sheets also include Energy, Mines and Resources aerial photography available and Landsat images covering the ecodistrict. Notes are also made concerning special features, land use, and general comments concerning the ecodistrict.

4. "Ecodistrict Component: Methodology and Discussion" includes:

- Background to the study and to the Ecological Land Survey approach;
- Data used and sources of the data (e.g. air photos, Landsat, Geological Survey of Canada Open Files, Northern Land Use Information Series Maps, etc.);

- Polygon numbering and ecodistrict identification;
- Discussion of each item on the Ecodistrict Fact Sheets;
- Canada Land Data System Coding Sheets; and
- Additional sources of information.

5. The report "Mining and Oil/Gas Activity and Interest Areas" examines:

- Principal mineral and hydrocarbon areas;
- Mining activities which are potentially disruptive to the environment of the study area;
- The mining process; and
- Types of resource data (both point and polygon) that are contained in the mining and oil/gas component of the data base.
  1. Types of resource present -- e.g. whether the resource is silver, zinc, tungsten, oil, gas, etc.
  2. Form of the resource -- e.g. whether it is a field, lode, or area of high concentration.
  3. Mineral status -- whether there is a major deposit or only know minor occurrences.
  4. Mining status -- e.g. whether there is a corporate claim, prospecting permit, and existing mine, suspended mining operations, etc.
  5. Support activities or facilities such as an airstrip, permanent base, pipeline, etc.
  6. Level of development -- potential producer, suspended producer, or area of resource interest.

C) Computer Data Bases

The above-mentioned map and report information have been converted into computer-compatible form for entry into the Canada Land Data System, Environment Canada's computerized land resource data system. Map lines have been scribed for digitization and descriptive data have been coded for computer entry. The computerized form will allow for more rapid and accurate integration and analysis of all the components of the overall data base.

INTEGRATION OF COMPONENT DATA SETS

One of the biggest problems of having a variety of land resource data is the integration of the greatly differing data sets. The relationships between these data sets, for instance between mineral, wildlife, relief, and vegetation data, are critical if sound land use decisions are to be made. Manual integration is very awkward and extremely time consuming, especially for large areas such as the whole of the Mackenzie Mountains Region. As an example of the complexity, a portion of one map sheet is shown with four overlays out of the total data base -- ecodistricts, mining claims, mineral occurrences, and areas of conservation interest. To every point or map polygon is attached a mass of data. Manually relating these data would be very difficult, and so computer assistance is sought.

Although the data for the Mackenzie Mountains Region are not on-line yet at the Canada Land Data System, a simple manually derived integration can illustrate the utility of the computer in analyzing complex land data. For a portion of the Pelly River Map Sheet, a data base extraction could include, for example:

- ecodistricts on the N.W.T. side of the map having mountain goat and mountain sheep (Dall's sheep or thinhorn sheep) winter or year-round range;
- areas of mining claims and mineral occurrences occurring only within these ecodistricts; or
- if the market for lead and zinc improved dramatically, areas of lead and/or zinc occurrences or concentrations could be selected separately (lead itself, zinc itself, lead and zinc occurring together, or lead and/or zinc occurring separately or together).

Such a selection could reveal potential areas of conflicts between mineral exploration and development and wildlife habitats or populations.

Much more complex selections could be done in a single step using the computer. For example, using the northern Yukon portion of the ecodistrict component of the Beaufort Sea data base, a sample selection was done to identify ecodistricts having some of the properties which would be more favorable for construction of a pipeline if it were ever decided that a pipeline had to be built in the area. These included:

- Average elevation less than 500m (selected by eliminating units with average elevation greater than 500m);
- Mean local relief less than 400m;
- Landforms -- not angular mountains or rounded mountains;
- Genetic materials -- not bedrock, organic, or residual/colluvial;
- Modifying process -- not mass wasting;
- Texture -- not blocky and not rubbly;
- Free water -- not saturated for very prolonged periods; and
- Lake cover -- less than 5% cover of lakes.

Based on the variables and values selected as best satisfying the desirable conditions, the computer integrated the data for these ecodistrict descriptors to identify map units satisfying all of the requirements, and these represented 27.8% of the total area. Thus, for regional screening, 72.2% of the area was rapidly eliminated from consideration. Additional selections could further refine the "suitable area", through narrowing the band of acceptable values. The computer could also be used to overlay other data sets, such as areas of conservation interest (IBP sites, Natural Area of Canadian Significance, existing or proposed parks, wildlife reserves or sanctuaries, etc.), to further refine the area.

Some sample computer selections using the Beaufort Sea data base include:

1. Canadian Wildlife Service areas of significance and Migratory Bird Sanctuaries;
2. Ecodistricts having high terrain trafficability; and
3. Ecodistricts having specific local relief ranges.

SUMMARY

As pressures continue to increase for the development of the non-renewable resources of the North, there is a need for multi-component, integrated land resource data bases to aid land use planning and land resource management. With the complexity of these data bases, computers can help in the integration and analyses of the component data sets. In the near future, one focus of the Lands Directorate's research will be on applying the existing four Northern data bases to a number of planning/management situations. A spin-off of this is examinations of the use of microcomputers, such as the Apple II, for accomplishing in northern communities, such as Whitehorse and Yellowknife, much of what can be done now by the Canada Land Data System in Ottawa. Included in this is the transfer of CLDS data files to microcomputer diskettes so that territorial government offices and regional federal offices can do their own data integration and analyses in the North. Also, discussions with territorial and regional federal agencies are an ongoing thing, with attempts constantly being made to more clearly identify planning needs and improved data and applications to meet these needs.

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